RED ELÉCTRICA DE ESPAÑA

CECOPMU project

November 22th, 2018

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Motivation

- **Uncertainty**:
  - Power electronics generation: behavior very dependent on its controls
  - Huge system with phenomena that exceed national borders

- **Need to operate the system as close as possible to its limits with the assurance that those limits will not be violated**
  - Safety margins too small can lead to incidents
  - Safety margins too large, inefficient use of the network

- **Provide more and better information to the control center**

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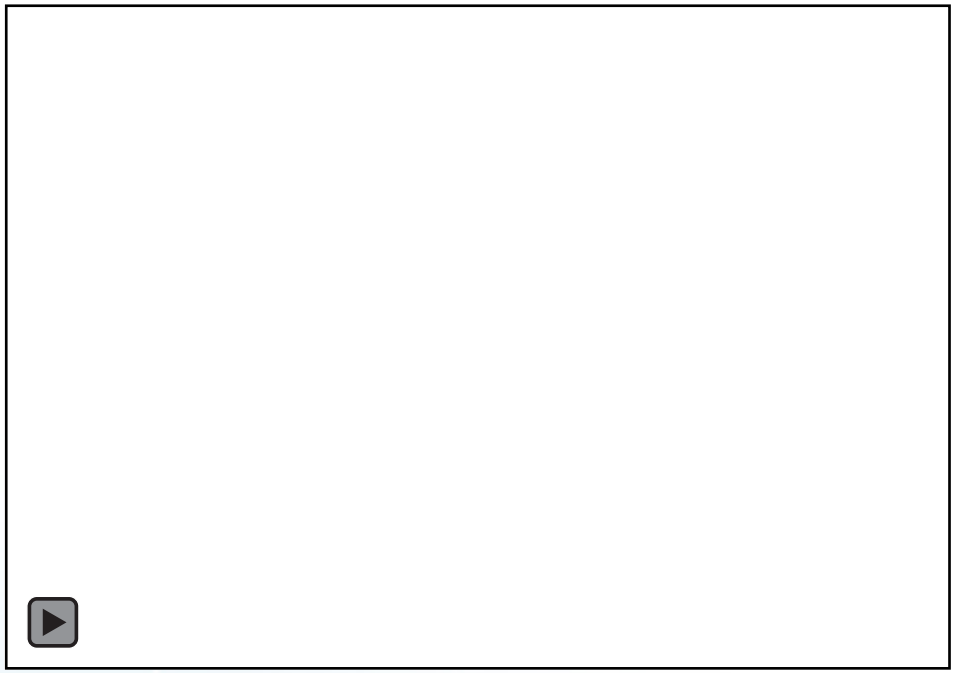
Motivation

- A good solution is to improve the system monitoring
- PMU provides:
  - Frequency
  - Voltage and current
    - magnitude
    - angle NEW
    - Three phase values NEW
  - Every 20 milliseconds Better
  - Synchronized and aligned measurements NEW



Inter-Area Oscillation - 1st December 2016
https://www.entsoe.eu/Documents/SOC%20documents/Regional_Groups_Continental_Europe/2017/CE_inter-area_oscillations_Dec_1st_2016_PUBLIC_V7.pdf

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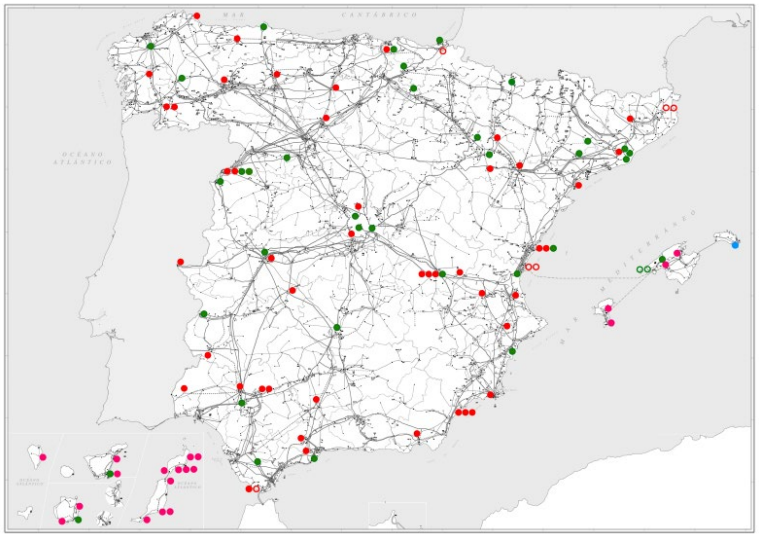
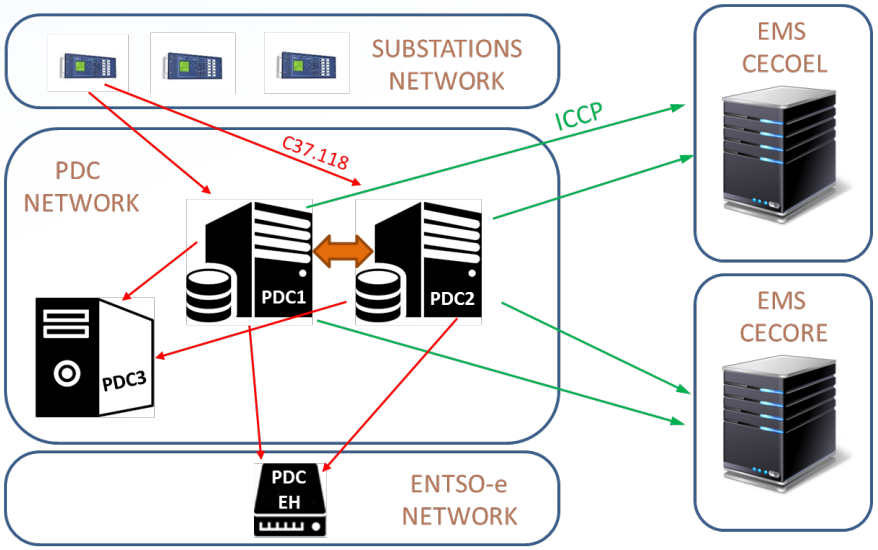
Deployment





- Almost 100 PMUs
- Protection relays function

- Redundant infrastructure
- Communication with EMS
- Real time data sharing with other TSOs

Data already available in the control center

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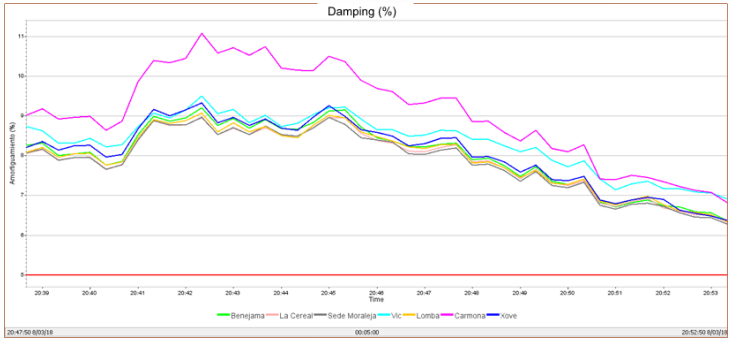
Applications

OSCILLATION MONITORING

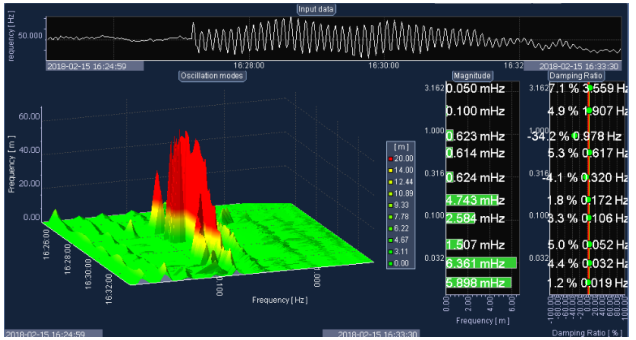
AMBIENT MONITORING

OSCILLATION EVENT DETECTION

INFORMATION



Oscillatory stability under normal situations



Oscillation information in oscillatory events

BENEFITS

- More efficient use of the network
- System security

- System security
- Take remedial actions with accurate information
- Real time assessment of the remedial actions

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Applications

	SHORT CIRCUIT DETECTION	UMBALANCE MONITORING	STATE ESTIMATION
INFORMATION	• Type of fault, clearance time • Area location • Report generation after 10 seconds	• Current imbalance • Voltage imbalance	• PDC provides to the state estimator voltage magnitude and phase
BENEFITS	• Improve restoration times • Safer restorations • Disturbance detection in neighboring networks that can affect to the own system	• Power quality assessment • Earlier failure detection (CTs, VTs)	• It´s expected get better and quicker estimations Under evaluation

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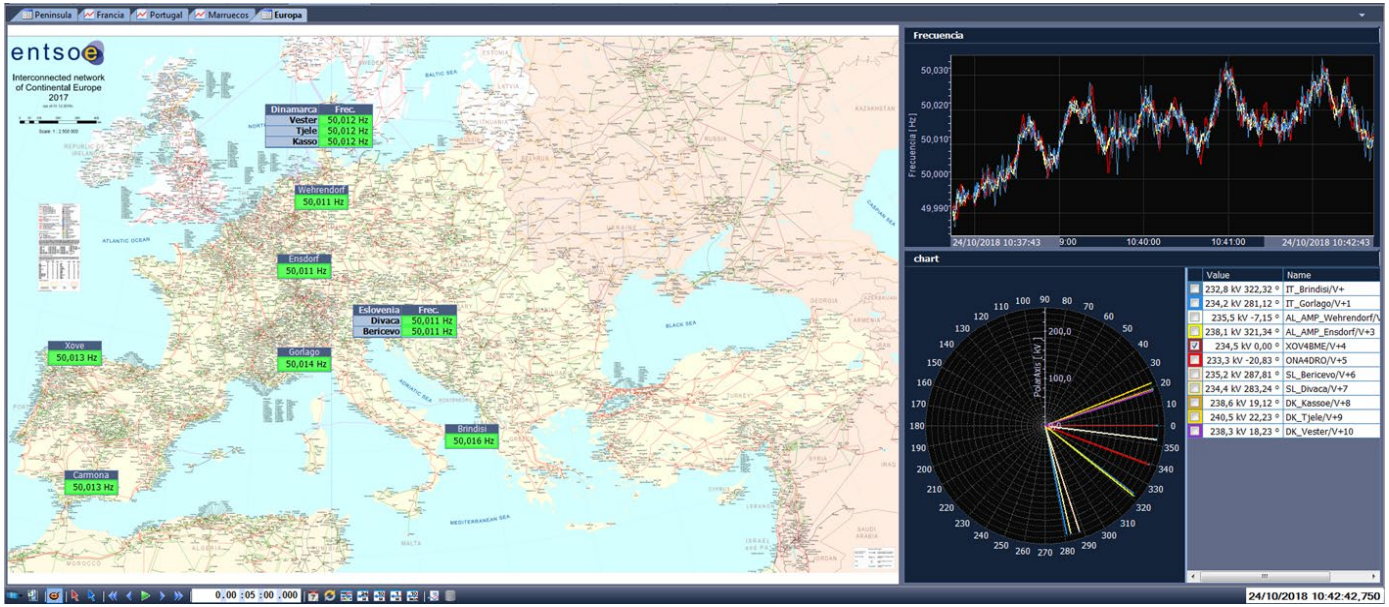
Applications

TSOs REAL TIME DATA SHARING



BENEFITS

- Improved knowledge of the system dynamics → Efficient use of the network and safer system operation
- Better real time information in large disturbances (2006 incident) → shorter restoration times

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Conclusions

- Providing PMU data to control center has improved the security and the efficiency.
- The main barrier to the implementation is the PMU synchronization requirements. Further developments are needed in this field (redundancy, reliability…)
- Main barriers to Wide Area Monitoring Systems exploitation:
  - Provide information not only data→ Further developments in data analysis, data mining… and data visualization.
  - Get used to this new data → Training. Further developments in Operator Training Systems (OTS) to use PMU data
- Wide Area Monitoring, Control and Protection Systems (WAMPAC) could be useful for system operation, more experience is needed in this field. REE has commissioned a WAMPAC in Balearic Islands

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